161

2868

LAW OFFICES
NELSON MULLINS RILEY & SCARBOROUGH, L.L.P.
A REGISTERED LIMITED LIABILITY PARTNERSHIP

CRAIG N. KILLEN
REGISTERED PATENT ATTORNEY
(803) 255-9382
INTERNET ADDRESS: CNK@NMRS.COM

KEENAN BUILDING, THIRD FLOOR
1330 LADY STREET
POST OFFICE BOX 11070 (29211)
COLUMBIA, SOUTH CAROLINA 29201
TELEPHONE (803) 799-2000
FACSIMILE (803) 256-7500
DIRECT FACSIMILE (803) 255-9103
WWW.NMRS.COM

OTHER OFFICES:
ATLANTA, GEORGIA
CHARLESTON, SOUTH CAROLINA
CHARLOTTE, NORTH CAROLINA
GREENVILLE, SOUTH CAROLINA
MYRTLE BEACH, SOUTH CAROLINA
RALEIGH, NORTH CAROLINA
WASHINGTON, DC
WINSTON-SALEM, NORTH CAROLINA

February 24, 2004

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In re: Application of Victor Giurgiutiu
Title: "IN-SITU STRUCTURAL HEALTH MONITORING, DIAGNOSTICS AND PROGNOSTICS SYSTEM UTILIZING THIN PIEZOELECTRIC SENSORS"
Serial No: 10/072,644 Filed: February 8, 2002
Our Ref: 16139/09021

Dear Sir:

The following is being transmitted herewith:

1. Petition to Withdraw the Holding of Abandonment Under 37 C.F.R. § 1.181, with Exhibits A, B, and C

Please charge any deficiency or credit any overpayment required by this action to our deposit account no. 50-1196, for which purpose an extra copy of this transmittal letter is attached.

Very truly yours,

Craig N. Killen
Reg. No. 35,218

I hereby certify that this correspondence and any referenced attachment and/or fee are being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the date listed above.

Martha Boynton
(Typed or printed name of person mailing paper or fee)

Martha Boynton
(Signature of person mailing paper or fee)

#7/WD from Atty

PATENT

ATTORNEY DOCKET NO.: 16139/09021

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of VICTOR GIURGIUTIU	)	Examiner: Shah, Kamini S.
Serial No.: 10/072,644	)	Art Unit: 2863
Filed: February 8, 2002	)	
Title: IN-SITU STRUCTURAL HEALTH MONITORING, DIAGNOSTICS AND PROGNOSTICS SYSTEM UTILIZING THIN PIEZOELECTRIC SENSORS	)	

PETITION TO WITHDRAW THE HOLDING OF ABANDONMENT UNDER 37 C.F.R. § 1.181

Mail Stop Petitions
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This is in response to a Notice of Abandonment mailed September 9, 2003 in relation to the above-identified application. A copy of the Notice of Abandonment is attached hereto at Exhibit A.

The Notice of Abandonment was based on Applicant's alleged failure to respond to the Office Action mailed on March 5, 2003. The Office Action set a shortened statutory period for reply three months from its mailing date. Thus, the period for response to the Office Action expired on June 5, 2003, but was extendable through September 5, 2003 with the payment of the fee for a three-month extension of time.

In fact, Applicant mailed a proper response to the Office

Action on September 4, 2003, with payment of the fee for a three-month extension. A copy of the response and all related documents is attached hereto at Exhibit B. The reply included a Certificate of Mailing pursuant to 37 C.F.R. § 1.8.

Applicant's amendment was received by the PTO Mail Room on September 8, 2003, as shown by the self-addressed postcard stamped by the PTO Mail Room on that date. A copy of the postcard is attached hereto at Exhibit C.

In view of the foregoing, it is respectfully requested that the holding of abandonment be withdrawn, that the application be reinstated to good standing, and that the application now proceed to further substantive examination by the PTO.

Please charge any deficiency or credit any overpayment required by this action to our deposit account no. 50-1196.

Respectfully submitted,

NELSON MULLINS RILEY & SCARBOROUGH

Craig N. Killen
Registration No. 35,218
P.O. Box 11070
Columbia, SC 29211-1070
(803) 255-9382
Fax (803) 255-9103

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as First Class Mail under 37 CFR 1.8 and is addressed to: Mail Stop Petitions, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on February 24, 2004.

Martha Boynton
Typed or printed name of person mailing paper or fee

Martha Boynton
Signature of person mailing paper or fee

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/072,644	02/08/2002	Victor Giurgiutiu	16139/09021	3274

7590 09/09/2003

Lloyd G. Farr
Nelson Mullins Riley & Scarborough, LLP
P.O. Box 11070
Columbia, SC 29211

MAR 02 2004

EXAMINER	
SHAH, KAMINI S	
ART UNIT	PAPER NUMBER
2863	

DATE MAILED: 09/09/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Pet. to Rmve
Docketed for
09N003
FSE

Notice of Abandonment	Application No.	Applicant(s)	
	10/072,644	GIURGIUTIU, VICTOR	
	Examiner	Art Unit	
	Kamini S Shah	2863	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

This application is abandoned in view of:

1. ☒ Applicant's failure to timely file a proper reply to the Office letter mailed on *03/05/03*.
   (a) ☐ A reply was received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the period for reply (including a total extension of time of _____ month(s)) which expired on _____.
   (b) ☐ A proposed reply was received on _____, but it does not constitute a proper reply under 37 CFR 1.113 (a) to the final rejection.
   (A proper reply under 37 CFR 1.113 to a final rejection consists only of: (1) a timely filed amendment which places the application in condition for allowance; (2) a timely filed Notice of Appeal (with appeal fee); or (3) a timely filed Request for Continued Examination (RCE) in compliance with 37 CFR 1.114).
   (c) ☐ A reply was received on _____ but it does not constitute a proper reply, or a bona fide attempt at a proper reply, to the non-final rejection. See 37 CFR 1.85(a) and 1.111. (See explanation in box 7 below).
   (d) ☒ No reply has been received.

2. ☐ Applicant's failure to timely pay the required issue fee and publication fee, if applicable, within the statutory period of three months from the mailing date of the Notice of Allowance (PTOL-85).
   (a) ☐ The issue fee and publication fee, if applicable, was received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the statutory period for payment of the issue fee (and publication fee) set in the Notice of Allowance (PTOL-85).
   (b) ☐ The submitted fee of $_____ is insufficient. A balance of $_____ is due.
   The issue fee required by 37 CFR 1.18 is $_____. The publication fee, if required by 37 CFR 1.18(d), is $_____.
   (c) ☐ The issue fee and publication fee, if applicable, has not been received.

3. ☐ Applicant's failure to timely file corrected drawings as required by, and within the three-month period set in, the Notice of Allowability (PTO-37).
   (a) ☐ Proposed corrected drawings were received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the period for reply.
   (b) ☐ No corrected drawings have been received.

4. ☐ The letter of express abandonment which is signed by the attorney or agent of record, the assignee of the entire interest, or all of the applicants.

5. ☐ The letter of express abandonment which is signed by an attorney or agent (acting in a representative capacity under 37 CFR 1.34(a)) upon the filing of a continuing application.

6. ☐ The decision by the Board of Patent Appeals and Interference rendered on _____ and because the period for seeking court review of the decision has expired and there are no allowed claims.

7. ☐ The reason(s) below:

Kamini S Shah
Primary Examiner
Art Unit: 2863

Petitions to revive under 37 CFR 1.137(a) or (b), or requests to withdraw the holding of abandonment under 37 CFR 1.181, should be promptly filed to minimize any negative effects on patent term.

LAW OFFICES
NELSON MULLINS RILEY & SCARBOROUGH, L.L.P.
A REGISTERED LIMITED LIABILITY PARTNERSHIP

CRAIG N. KILLEN
REGISTERED PATENT ATTORNEY
(803) 255-9382
INTERNET ADDRESS: CNK@NMRS.COM

KEENAN BUILDING, THIRD FLOOR
1330 LADY STREET
POST OFFICE BOX 11070 (29211)
COLUMBIA, SOUTH CAROLINA 29201
TELEPHONE (803) 799-2000
FACSIMILE (803) 256-7500
DIRECT FACSIMILE (803) 255-9103
WWW.NMRS.COM

OTHER OFFICES:
ATLANTA, GEORGIA
CHARLESTON, SOUTH CAROLINA
CHARLOTTE, NORTH CAROLINA
GREENVILLE, SOUTH CAROLINA
MYRTLE BEACH, SOUTH CAROLINA
RALEIGH, NORTH CAROLINA
WINSTON-SALEM, NORTH CAROLINA

September 4, 2003

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In re: Application of Victor Giurgiutiu
Title: "IN-SITU STRUCTURAL HEALTH MONITORING, DIAGNOSTICS AND PROGNOSTICS SYSTEM UTILIZING THIN PIEZOELECTRIC SENSORS"
Serial No: 10/072,644 Filed: February 8, 2002
Our Ref: 16139/09021

Dear Sir:

The following are being transmitted herewith:

1. Amendment, 12 pages
2. 10 sheets of formal drawings, Figures 1-12
3. Fee Transmittal for FY 2003
4. Check in the amount of $588.00

Please charge any deficiency or credit any overpayment required by this action to our deposit account no. 50-1196, for which purpose an extra copy of this transmittal letter is attached.

Very truly yours,

Craig N. Killen
Reg. No. 35,218

I hereby certify that this correspondence and any referenced attachment and/or fee are being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the date listed above.

Martha Boynton
(Typed or printed name of person mailing paper or fee)

Martha Boynton
(Signature of person mailing paper or fee)

PTO/SB/17 (01-03)
Approved for use through 04/30/2003. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

FEE TRANSMITTAL for FY 2003

Effective 01/01/2003. Patent fees are subject to annual revision.

[XX] Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 588

Complete if Known	
Application Number	10/072,644
Filing Date	February 8, 2002
First Named Inventor	Victor Giurgiutiu
Examiner Name	Shah, Kamini S.
Art Unit	2863
Attorney Docket No.	16139/09021

METHOD OF PAYMENT *(check all that apply)*

[XX] Check [ ] Credit card [ ] Money Order [ ] Other [ ] None

[XX] Deposit Account:

Deposit Account Number: 50-1196

Deposit Account Name: Nelson Mullins Riley & Scarborough

The Commissioner is authorized to: *(check all that apply)*

[ ] Charge fee(s) indicated below [XX] Credit any overpayments

[XX] Charge any additional fee(s) during the pendency of this application

[ ] Charge fee(s) indicated below, **except for the filing fee** to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	750	2001	375	Utility filing fee	
1002	330	2002	165	Design filing fee	
1003	520	2003	260	Plant filing fee	
1004	750	2004	375	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	

SUBTOTAL (1) ($)

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

		Extra Claims		Fee from below	Fee Paid
Total Claims	29	-20** =	9	X 9	= 81
Independent Claims	4	- 3** =	1	X 42	= 42
Multiple Dependent					=

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	84	2201	42	Independent claims in excess of 3
1203	280	2203	140	Multiple dependent claim, if not paid
1204	84	2204	42	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 123

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	410	2252	205	Extension for reply within second month	
1253	930	2253	465	Extension for reply within third month	465
1254	1,450	2254	725	Extension for reply within fourth month	
1255	1,970	2255	985	Extension for reply within fifth month	
1401	320	2401	160	Notice of Appeal	
1402	320	2402	160	Filing a brief in support of an appeal	
1403	280	2403	140	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,300	2453	650	Petition to revive - unintentional	
1501	1,300	2501	650	Utility issue fee (or reissue)	
1502	470	2502	235	Design issue fee	
1503	630	2503	315	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	750	2809	375	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	750	2810	375	For each additional invention to be examined (37 CFR 1.129(b))	
1801	750	2801	375	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 465

SUBMITTED BY				(Complete if applicable)	
Name (Print/Type)	Craig N. Killen	Registration No. (Attorney/Agent)	35,218	Telephone	(803) 255-9382
Signature	Craig N. Killen			Date	Sept. 4, 2003

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

PATENT
ATTORNEY DOCKET NO.: 16139/09021

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of VICTOR GIURGIUTIU	)	Examiner: Shah, Kamini S
Serial No.: 10/072,644	)	Art Unit 2863
Filed: February 8, 2002	)	
For: IN-SITU STRUCTURAL HEALTH MONITORING, DIAGNOSTICS AND PROGNOSTICS SYSTEM UTILIZING THIN PIEZOELECTRIC SENSORS	)	

AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Office Action mailed March 5, 2003, please amend the above-identified application as follows:

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 3 of this paper.

Amendments to the Drawings begin on page 8 of this paper and include a full set of replacement sheets intended to be the formal drawings for this application.

Remarks begin on page 9 of this paper.

Amendments to the Specification:

Please replace the paragraph at page 15, line 16 through page 16, line 8 with the following amended paragraph:

The examples provided above, i.e., impedance sensing and ultrasonic sensing, rely on active sensors to measure structural characteristics. The present invention may also, however, be used in passive modes to detect structural damage. In certain of ~~there~~ these embodiments, a plurality of sensors is disposed in a predetermined orientation relative to each other and at known positions on the structure. The sensor outputs are monitored intermittently or continuously, even though the sensors may not be engaged in either of the active measurement procedures described above. Damage events may be identified through the reception of stress waves generated in the structure through impacts or other material disruptions. Certain waves may, for example, indicate an occurrence of a low-velocity impact. The sensor may also, however, detect acoustic emission signals that indicate damage has occurred. By determining and recording the location and time of damage events, a record may be compiled to predict the structure's remaining operative life.

Please replace the paragraph at page 19, line 17 through page 20, line 4 with the following amended paragraph:

For impedance sensing, an adjustable-voltage-power gain-phase impedance analyzer 46 excites the transducers, which output measurement information back to analyzer 46. Analyzer 46 includes software ~~algarithons~~ algorithms to analyze the sensor data to determine the locations and orientation of damage features as described above. Alternatively, analyzer 46 may forward the data to computer 38 for analysis. Generally, computer 38 houses the system's software components, the operation of which is generally described above and which may include non-destructive evaluation and imaging software package 48, monitoring diagnostics and analysis software package 52 and/or artificial intelligence, neural-network and data mining software 54.

Amendments to the claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of claims:

Claims 1-2 (cancelled)

Claim 3 (new): A system operative to detect a damage feature in a thin wall structure, said system comprising:

an array of piezoelectric wafer sensors embedded on said structure in a predetermined pattern;

a generator operative to excite at least one of said sensors to produce ultrasonic waves having a frequency of at least about 200 KHz in said structure; and

a signal processor operative to process received signals at least two of said sensors so as to detect said damage feature.

Claim 4 (new): A system as set forth in claim 3, wherein said generator is operative to excite each of said sensors in said array in round-robin fashion.

Claim 5 (new): A system as set forth in claim 4, wherein said signal processor is operative to determine a location of said damage feature based on a collection of data representing received signals at a plurality of said sensors after round-robin excitation of all of said sensors in said array.

Claim 6 (new): A system as set forth in claim 4, wherein said array comprises at least four of said sensors.

Claim 7 (new): A system as set forth in claim 3, wherein said frequency of said ultrasonic waves include a significant component at approximately 300 KHz.

Claim 8 (new): A system as set forth in claim 7, wherein said ultrasonic waves are Lamb waves.

Claim 9 (new): A system as set forth in claim 3, wherein said frequency of said ultrasonic waves falls in the megahertz range.

Claim 10 (new): A system as set forth in claim 3, wherein said ultrasonic waves are Lamb waves.

Claim 11 (new): A system as set forth in claim 10, wherein said sensors are adhered to a surface of said thin wall structure.

Claim 12 (new): A system as set forth in claim 3, wherein said wafer sensors have a planar surface area no greater than approximately 169 mm^2 and a thickness no greater than approximately 0.49 mm.

Claim 13 (new): A system as set forth in claim 12, wherein said wafer sensors are generally rectangular.

Claim 14 (new): A system operative to detect a damage feature in a structure, said system comprising:

an array of piezoelectric wafer active sensors embedded on said structure in a predetermined pattern, said wafer sensors having a planar surface area no greater than approximately 169 mm^2 and a thickness no greater than approximately 0.49 mm;

a generator operative to excite each of sensors in said

array in round-robin fashion to produce ultrasonic waves in said structure; and

a signal processor operative to process received signals at least two of said sensors so as to detect said damage feature.

Claim 15 (new): A system as set forth in claim 14, wherein said signal processor is operative to determine a location of said damage feature based on a collection of data representing received signals at a plurality of said sensors after round-robin excitation of all of said sensors in said array.

Claim 16 (new): A system as set forth in claim 14, wherein said array comprises at least four of said sensors.

Claim 17 (new): A system as set forth in claim 14, wherein said frequency of said ultrasonic waves falls in a range of 200 kHz to high megahertz.

Claim 18 (new): A system as set forth in claim 17, wherein said frequency of said ultrasonic waves is approximately 300 KHz.

Claim 19 (new): A system as set forth in claim 18, wherein said ultrasonic waves are Lamb waves.

Claim 20 (new): A system as set forth in claim 14, wherein said sensors are adhered to a surface of said thin wall structure.

Claim 21 (new): A method of detecting impact to a structure by a foreign object, said method comprising steps of:

(a) providing an array of piezoelectric wafer sensors embedded on said structure in a predetermined pattern;

(b) simultaneously monitoring said sensors in said array to

detect impact signals caused by stress waves produced in said structure by said foreign object; and

(c) processing a collection of said impact signals so as to ascertain a location of said impact.

Claim 22 (new): A method as set forth in claim 21, wherein said sensors are simultaneously monitored in step (b) on a continuous basis.

Claim 23 (new): A method as set forth in claim 21, wherein said sensors are simultaneously monitored in step (b) on an intermittent basis.

Claim 24 (new): A method as set forth in claim 21, wherein said array comprises at least four of said sensors.

Claim 25 (new): A method as set forth in claim 24, wherein said wafer sensors have a planar surface area no greater than approximately 169 mm^2 and a thickness no greater than approximately 0.49 mm.

Claim 26 (new): A method as set forth in claim 25, wherein said wafer sensors are generally rectangular.

Claim 27 (new): A method as set forth in claim 21, further comprising the following steps:

(d) exciting at least one of said sensors to produce ultrasonic waves having a frequency of at least 200 KHz in said structure; and

(e) detecting said ultrasonic waves at said sensors so as to ascertain the presence of damage features in said structure.

Claim 28 (new): A method of detecting a damage feature

present within a predetermined sensing zone in a thin wall structure, said method comprising steps of:

(a) providing at least one piezoelectric wafer sensor embedded on said structure;

(b) exciting said sensor with a first electrical signal spanning a predetermined frequency range;

(c) deriving first data characteristic of a drive-point impedance of said wafer sensor as embedded on said structure;

(d) exciting said sensor with a second electrical signal spanning said predetermined frequency range;

(e) deriving second data characteristic of said drive-point impedance of said wafer sensor; and

(f) comparing said first data and said second data.

Claim 29 (new): A method as set forth in claim 28, wherein a plurality of said wafer sensors are provided on said structure in an array.

Claim 30 (new): A method as set forth in claim 29, wherein said sensors are arranged in said array so as to have overlapping sensing zones.

Claim 31 (new): A method as set forth in claim 30, wherein said wafer sensors have a planar surface area no greater than approximately 169 mm^2 and a thickness no greater than approximately 0.49 mm.

Amendments to the Drawings:

The attached set of formal drawings replaces the original informal drawing sheets filed with the present application.

Attachment: Replacement drawing sheets (10 sheets)

REMARKS

Favorable reconsideration and allowance of the present application are respectfully requested.

Claims 1-2 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Pat. No. 6,006,163 to Lichtenwalner. By the above amendment, claims 1-2 have been cancelled without prejudice. As such, the rejection of these claims is believed to be moot.

While claims 1-2 have been cancelled, some comments about differences between Lichtenwalner and the subject matter described in the present application are in order. In this regard, Lichtenwalner discloses a system utilizing piezoelectric transducers operating at frequencies up to 100 KHz. Col. 6, line 23 and claim 4. The patent states that transducer signals are digitized and the transfer function (TF) amplitude and phase of each actuator/sensor pair is computed. Col. 4, lines 30-33. The calculated transfer function is then compared against a baseline transfer function for that actuator/sensor pair previously obtained with the structure in an undamaged state. Col. 4, lines 33-37.

After the transfer function comparison, a damage index (DI) for each actuator can be determined. Col. 6, lines 51-54. The actuator with the highest DI is used to identify the damage zone. Col. 6, lines 64-65. Center of mass equations, with appropriate

substitution of the DI values for the point-mass values, are used to determine the location of damage. Col. 7, lines 7-9. Contrasting the disclosed technique with ultrasonic techniques, Lichtenwalner states that certain experimental results were validated using "[s]ubsequent ultrasonic inspection." Col. 9, lines 10-11.

The present application, on the other hand, discloses a system utilizing arrays of very small piezoelectric wafer active sensors. In many cases, for example, the length of each wafer will be less than 13mm per side (i.e., 169mm^2 surface area) and have a thickness of no greater than 0.49mm thick. Both active and passive evaluation techniques can be employed using such an array. For example, true ultrasonic (i.e., 200KHz and above) elastic waves can be propagated through a thin wall structure using the sensors. Sensors can be actuated in round robin fashion with detection at all sensors in the array to produce a rich matrix of information. The matrix can be analyzed using various computational techniques to determine the location of a damage feature in the structure. Advantageously, sensors of this type can directly excite Lamb waves into the structure without the need for mode conversion.

Alternatively, drive point impedance measurements can be taken at each sensor in order to detect changes in a sensing zone around that sensor. In other words, damage in the sensing zone

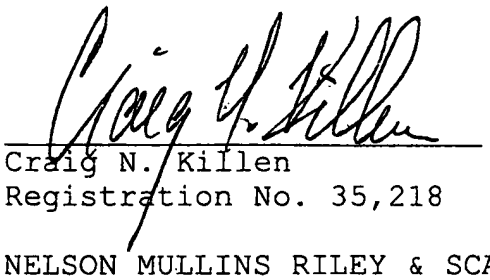
will cause changes in the drive point impedance of the particular sensor. These changes will be reflected in the sensor's impedance spectrum. As a result, impedance measurements taken before and after occurrence of the damage feature can be utilized to detect its presence. Preferably, sensors in the array are arranged so that their impedance sensing zones will overlap.

Passive detection modes are also contemplated in which the sensor outputs are monitored intermittently or continuously for stress waves in the structure. Stress waves may indicate, for example, that a foreign object has impacted the structure. Triangulation or other suitable techniques may be utilized to determine the impact's position with respect to the sensors.

Claims 3-31 have been added to set forth additional aspects of Applicant's inventive subject matter, many of such aspects being reflected in the above discussion. Of these new claims, claims 3, 14, 21 and 28 are independent claims. Each new claim is fully supported by the application as filed and is believed to be distinguishable over the art of record.

Based on the above, it is respectfully submitted that the present application, including claims 3-31, is in condition for allowance, and action to such effect is earnestly solicited. The Examiner is invited to telephone the undersigned should any minor issues remain after consideration of the above amendment.

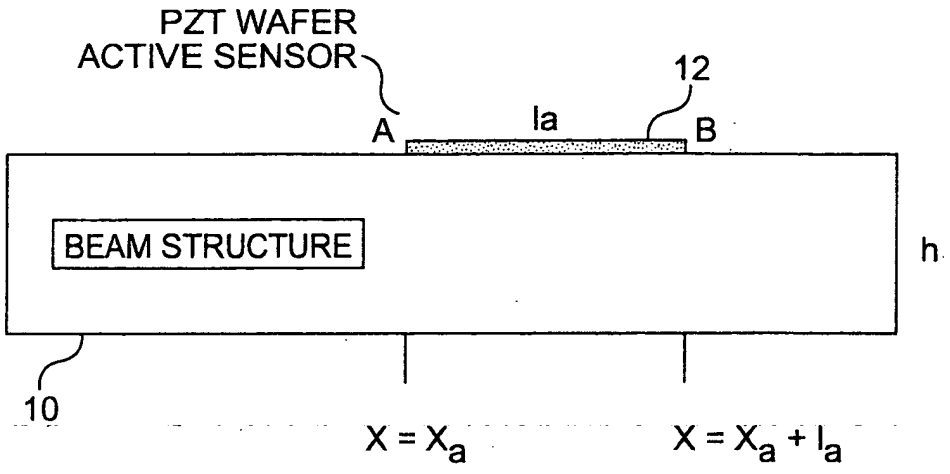
Respectfully submitted,



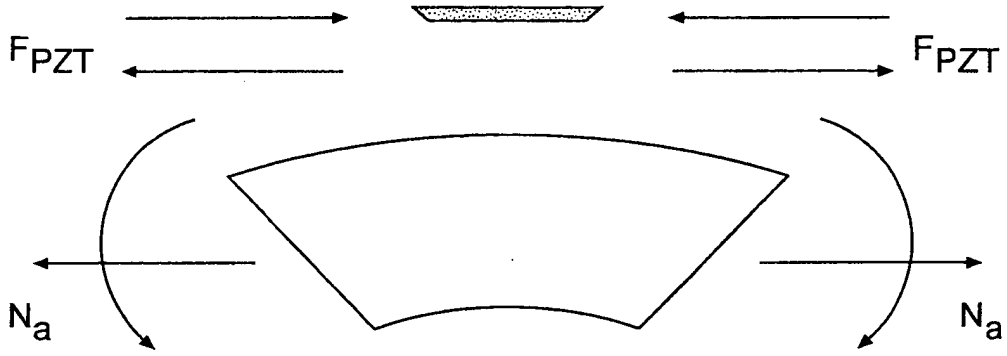
Craig N. Killen
Registration No. 35,218

NELSON MULLINS RILEY & SCARBOROUGH
P.O. Box 11070
Columbia, SC 29211-1070
(803) 255-9382
Fax (803) 255-9103

Application of Victor Giurgiutiu
Serial No: 10/072,644
Examiner: Shah, Kamini S.
Art Unit: 2863



PZT STRAIN AND DISPLACEMENT, ε_{PZT} AND U_{PZT}



BEAM EXTENSION ε_α
ROTATION $\theta = dw/dx$
CURVATURE $1/\rho$

FIG. 1

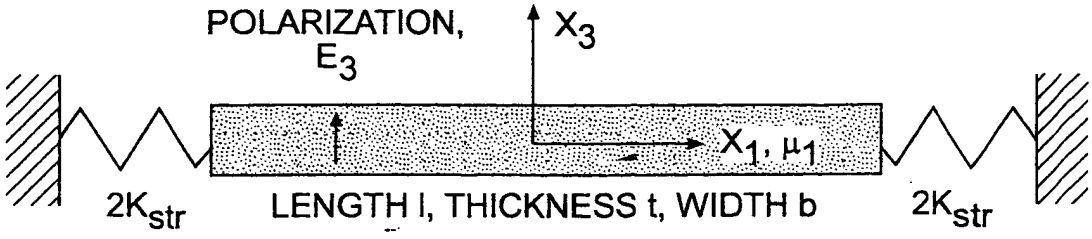


FIG. 2

Application of Victor Giurgiutiu
Serial No: 10/072,644
Examiner: Shah, Kamini S.
Art Unit: 2863

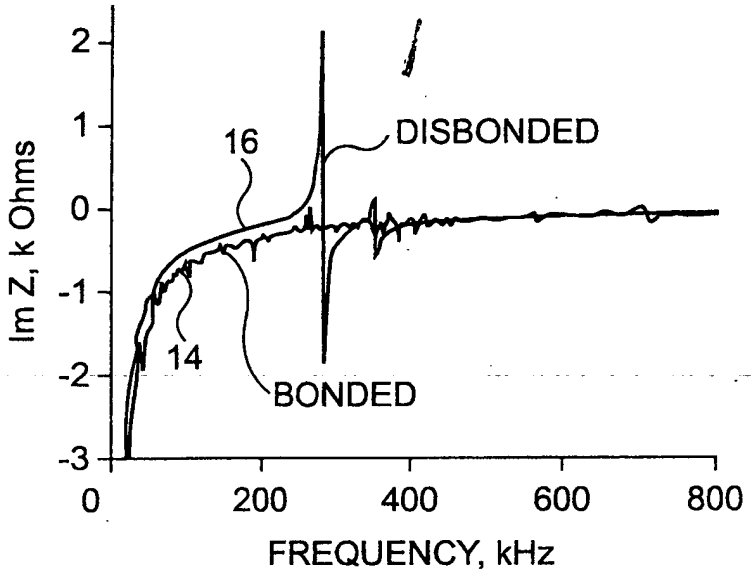


FIG. 3

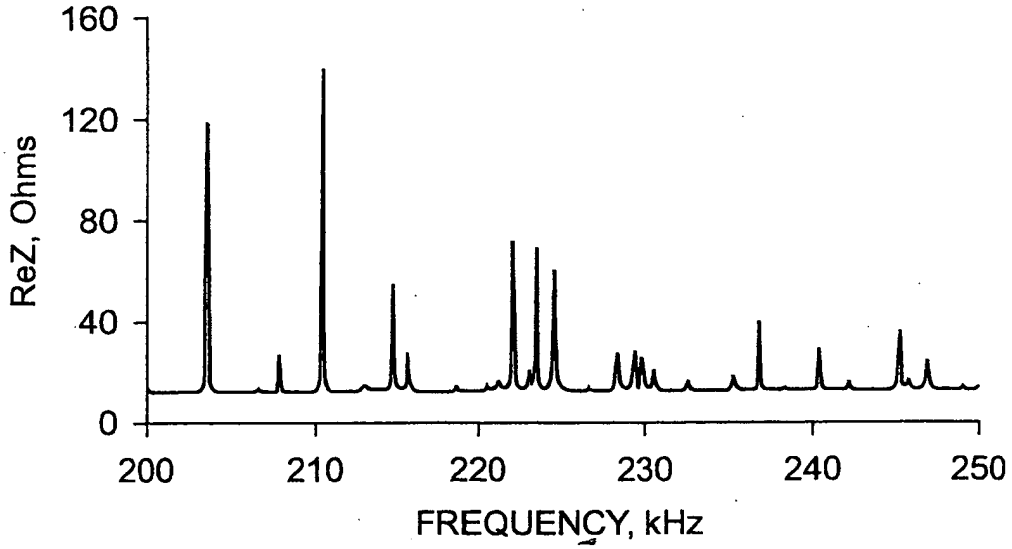


FIG. 4

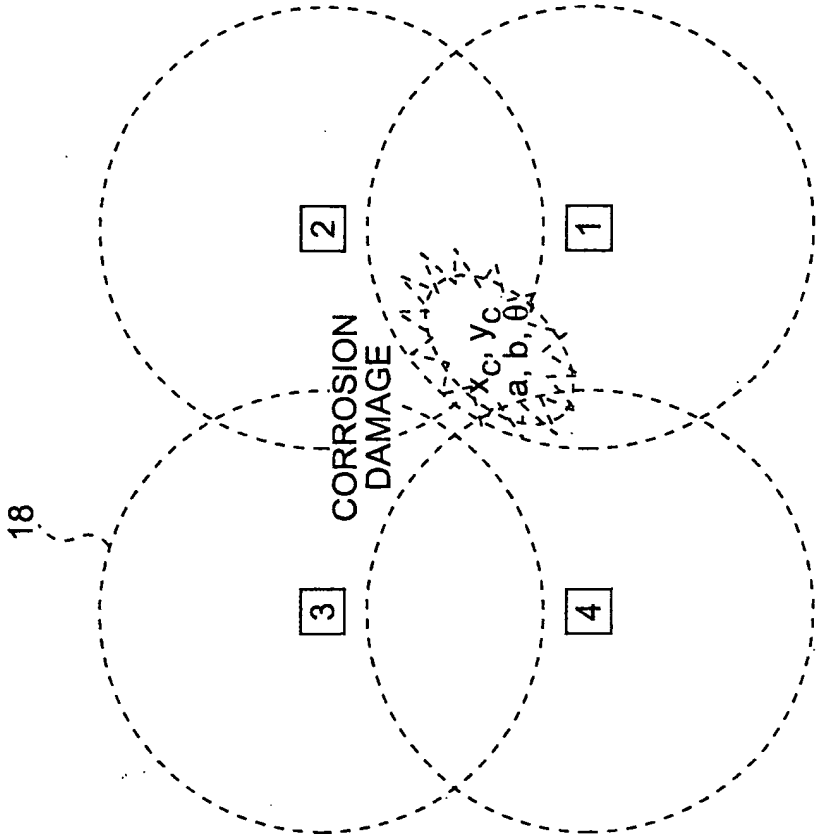


FIG. 5b

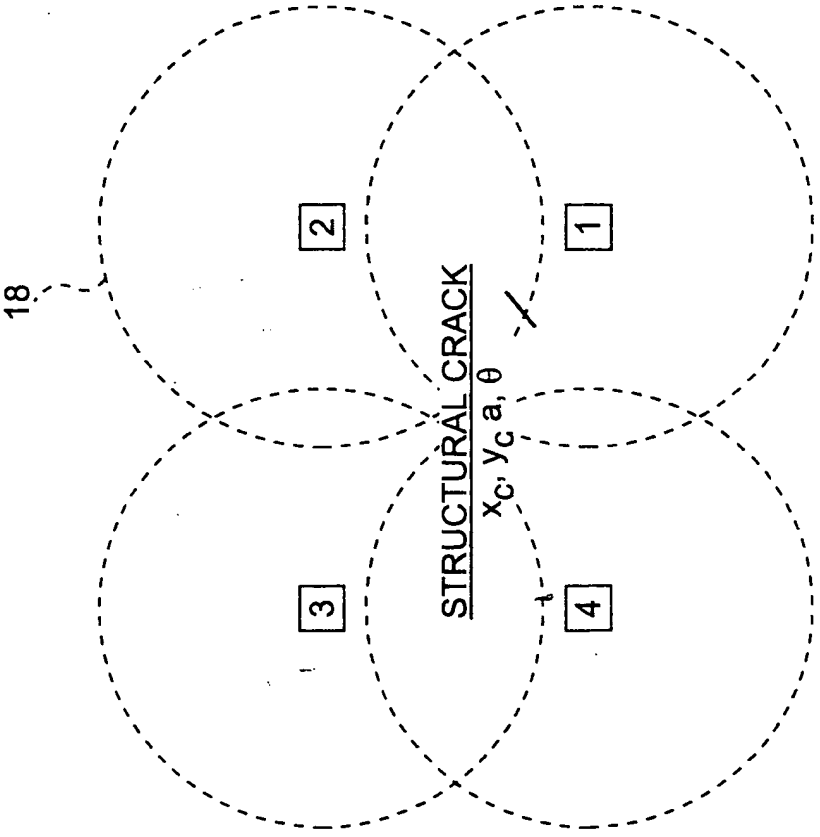


FIG. 5a

Application of Victor Giurgiutiu
Serial No: 10/072,644
Examiner: Shah, Kamini S.
Art Unit: 2863

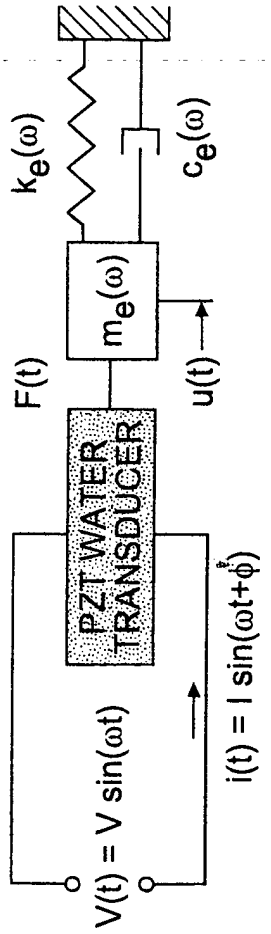


FIG. 6

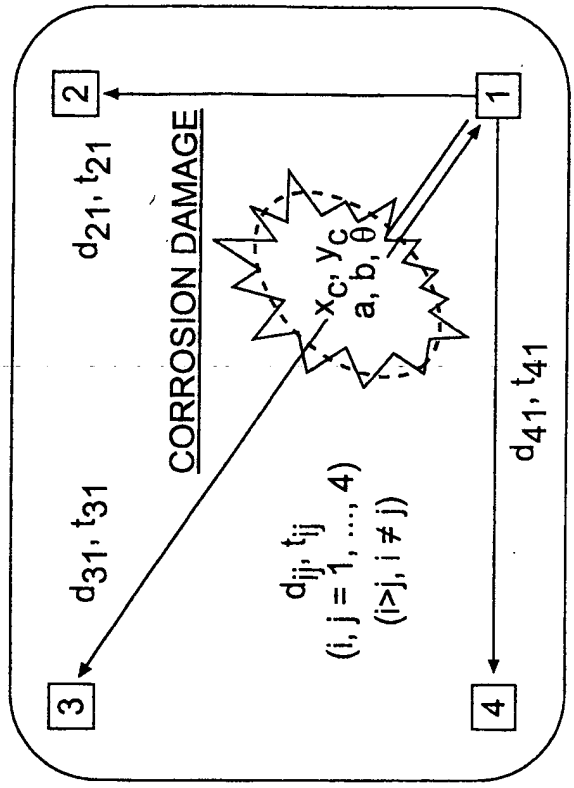


FIG. 7b

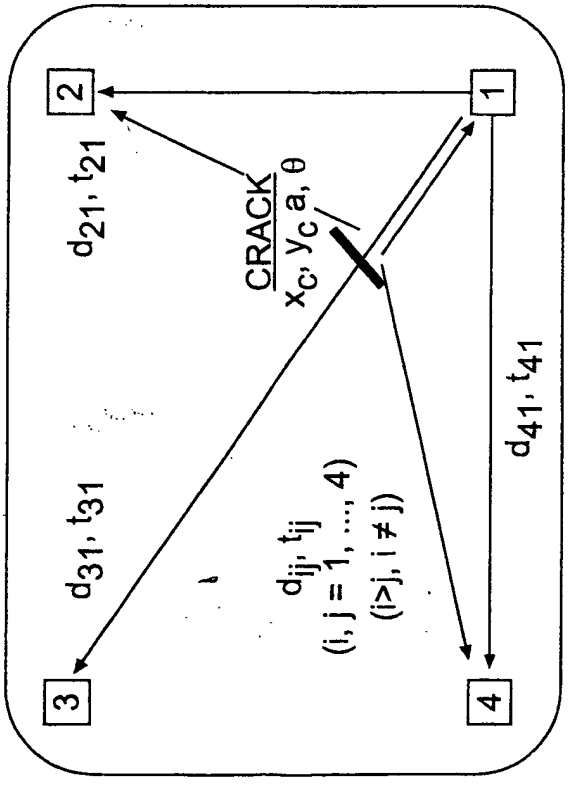


FIG. 7a

Application of Victor Giurgiutiu
Serial No: 10/072,644
Examiner: Shah, Kamini S.
Art Unit: 2863

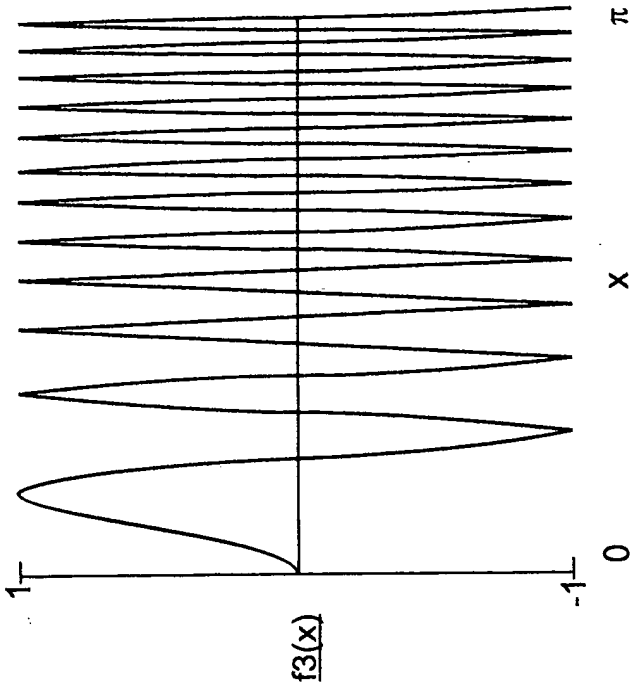


FIG. 8b

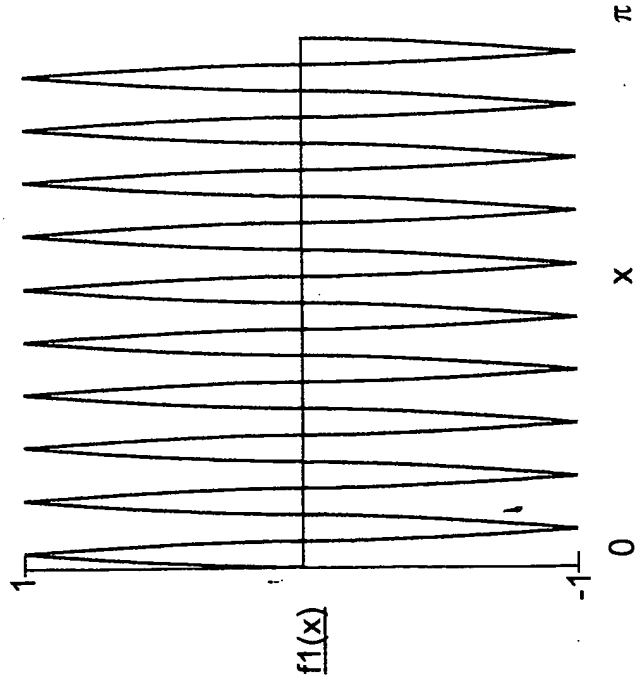


FIG. 8a

Application of Victor Giurgiutiu
Serial No: 10/072,644
Examiner: Shah, Kamini S.
Art Unit: 2863

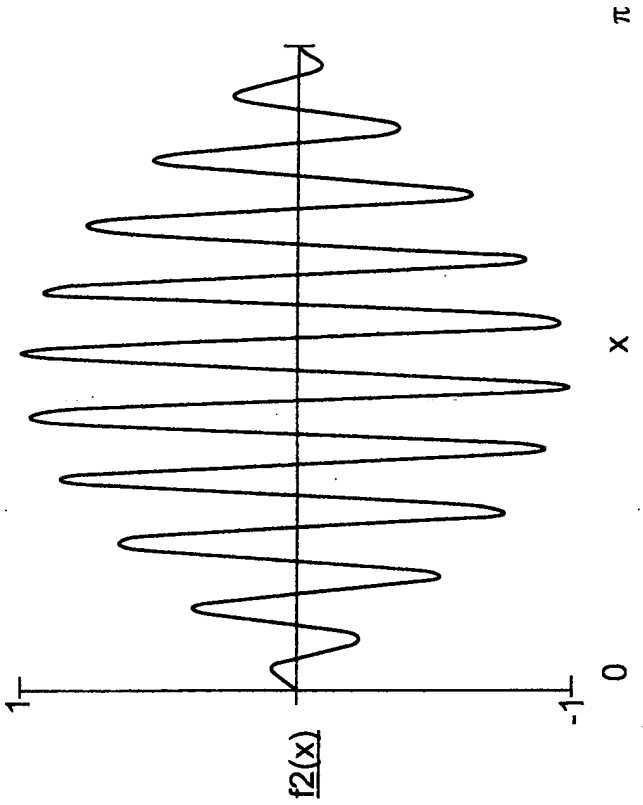


FIG. 8d

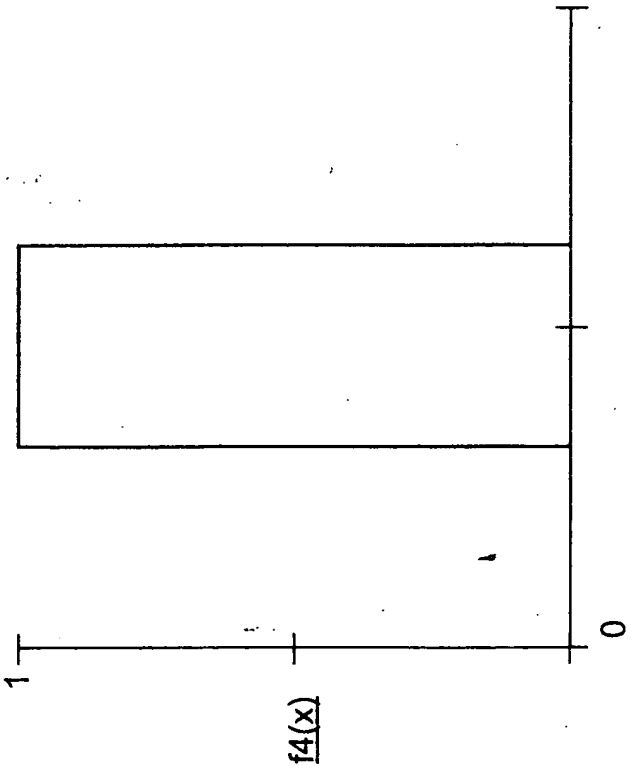


FIG. 8c

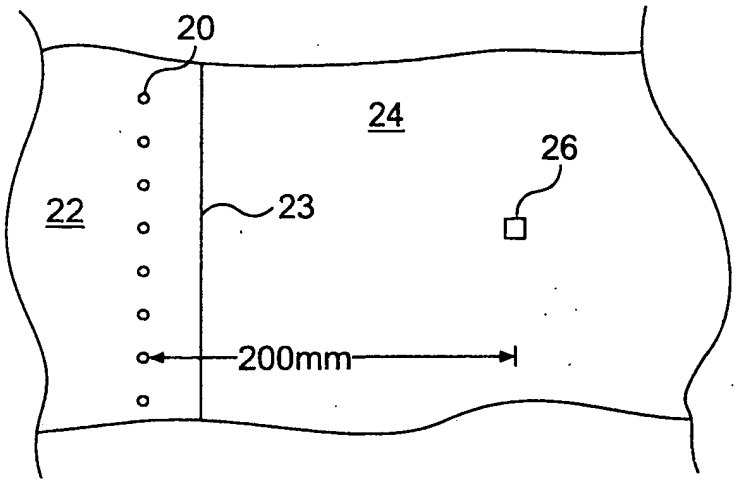


FIG. 9a

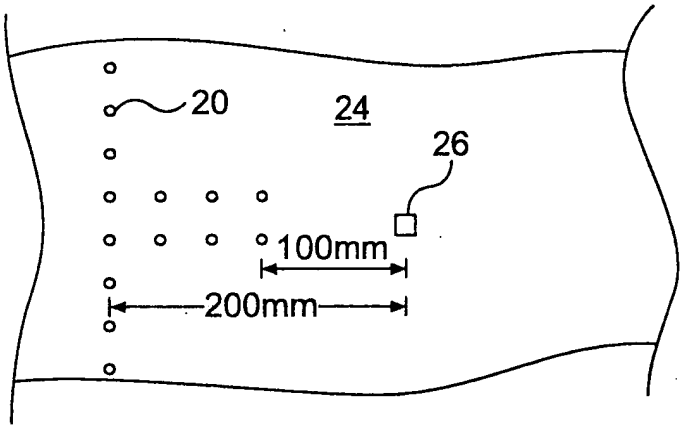


FIG. 9b

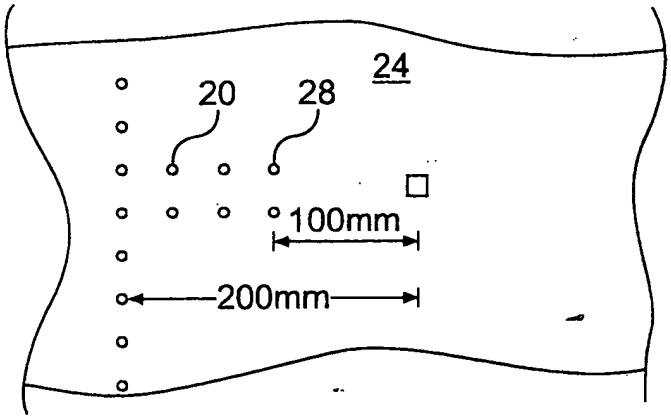


FIG. 9c

Application of Victor Giurgiutiu
Serial No: 10/072,644
Examiner: Shah, Kamini S.
Art Unit: 2863

FIG. 10a

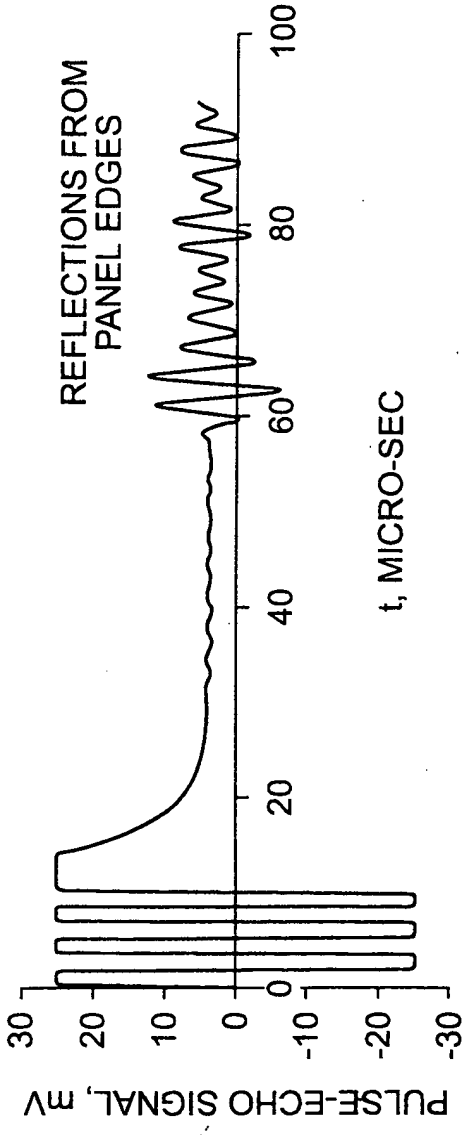
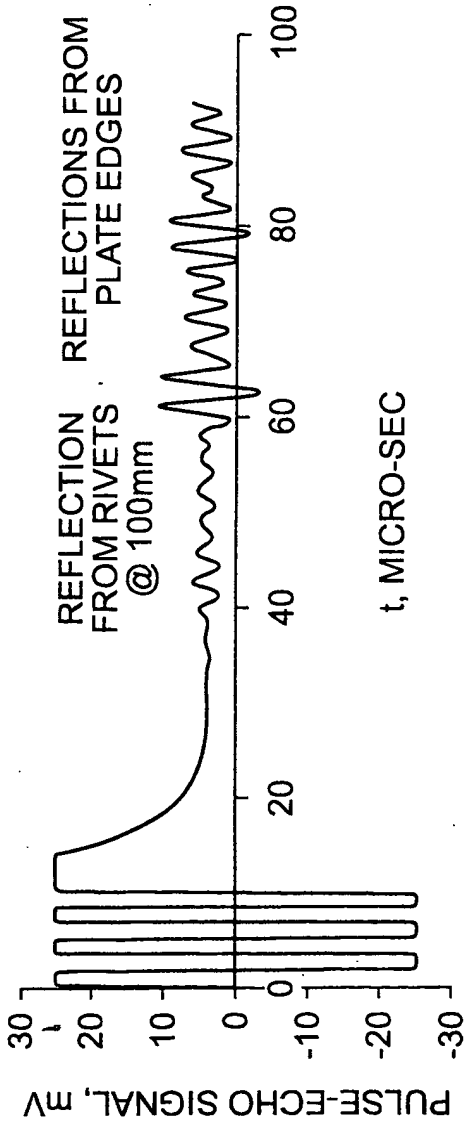


FIG. 10b



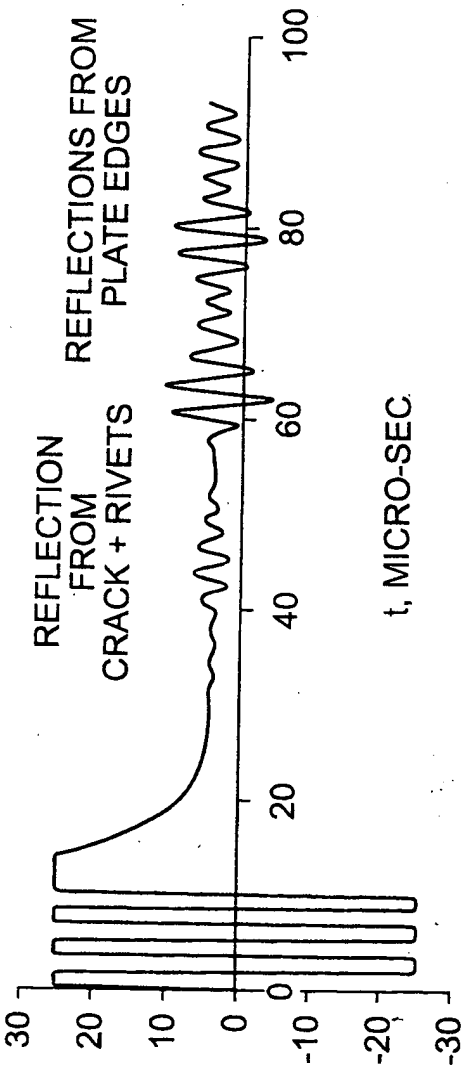


FIG. 10c

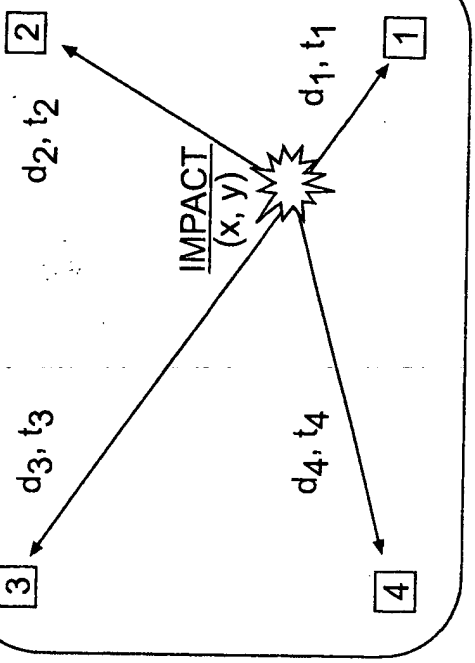


FIG. 11

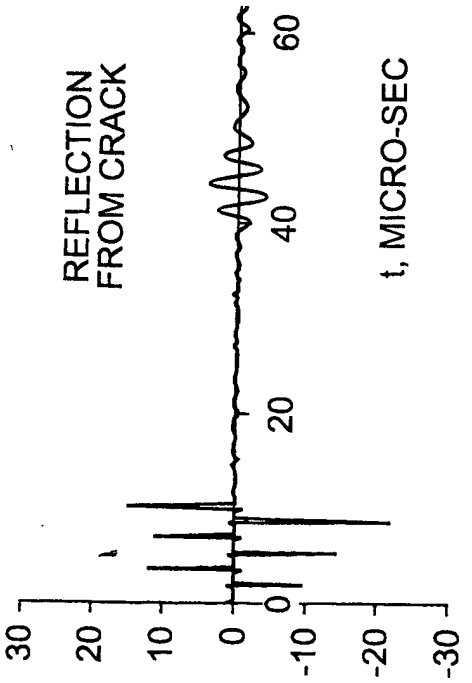


FIG. 10d

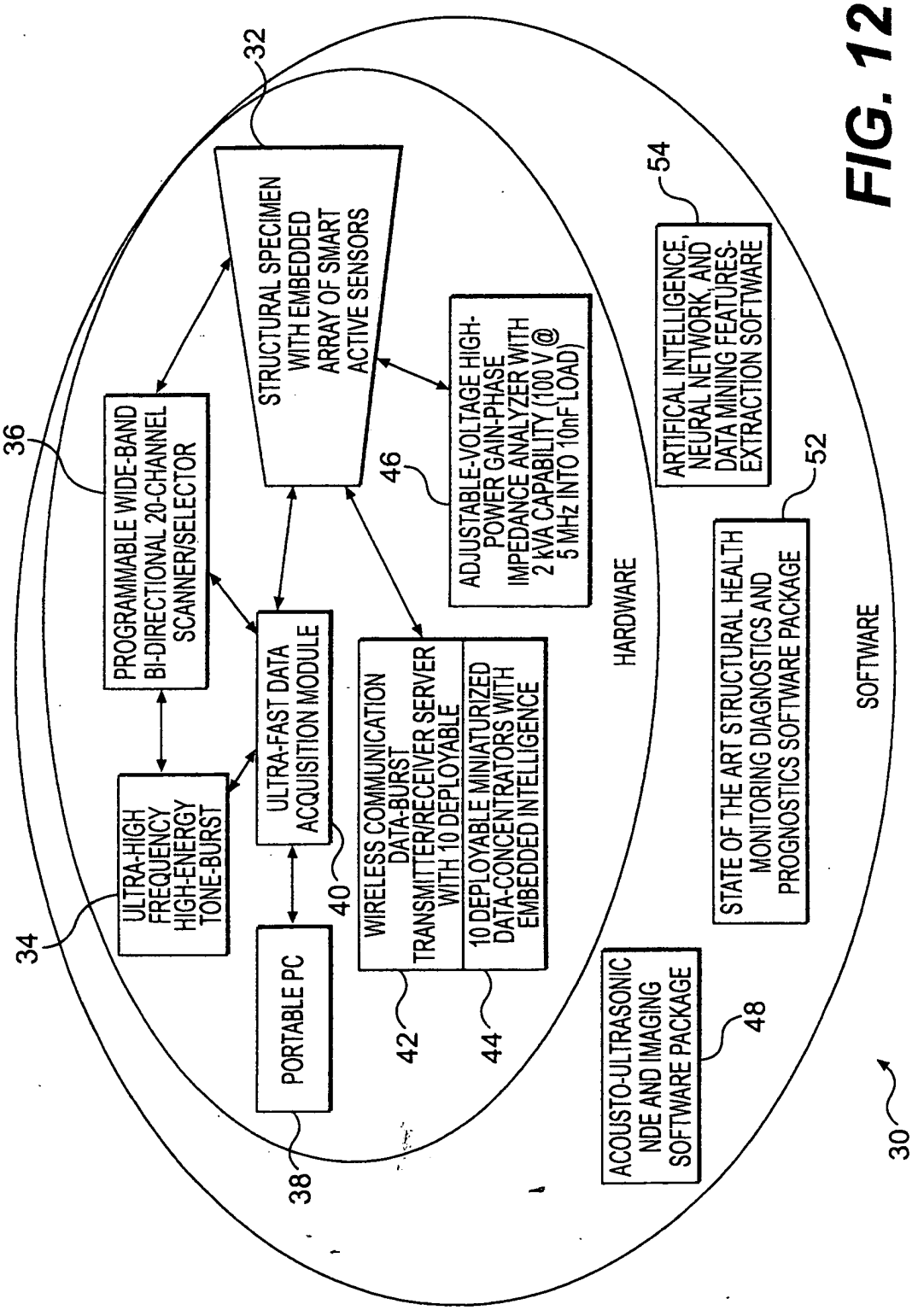
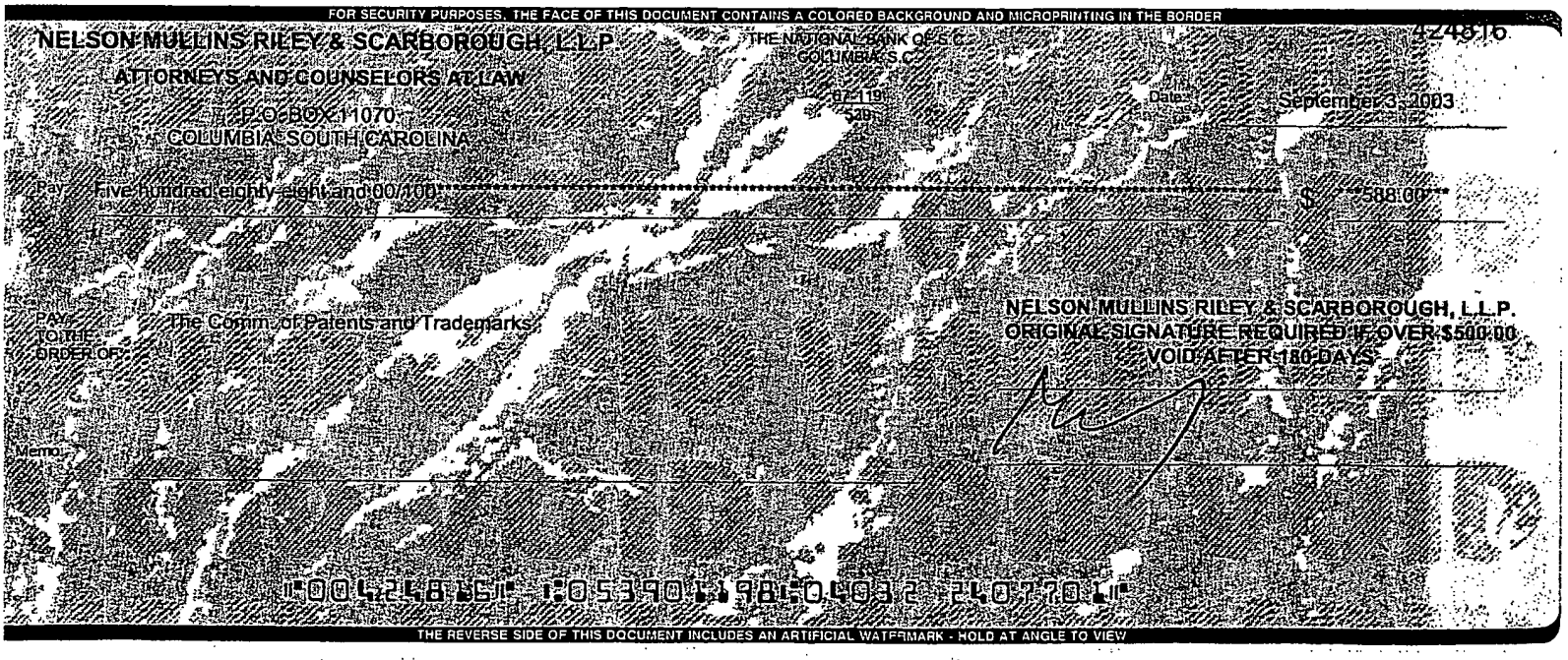


FIG. 12

5The stamp of the U.S. Patent & Trademark Office hereon acknowledges receipt of the following:

1. Amendment, 11 pages
2. Cover letter w/ first class mail certificate
3. 10 sheets of formal drawings, Figs. 1-12
4. Fee Transmittal for FY 2003
5. Check in the amount of $588.00

Application of Victor Giurgiutiu
Title: In-Situ Structural Health Monitoring, Diagnostics And Prognostics System Utilizing Thin Piezoelectric Sensors
Serial No: 10/072,644 filed: 2-8-02
Our Ref: 16139/09021
Date: September 4, 2003



5The stamp of the U.S. Patent & Trademark Office hereon acknowledges receipt of the following:

1. Amendment, 11 pages
2. Cover letter w/ first class mail certificate
3. 10 sheets of formal drawings, Figs. 1-12
4. Fee Transmittal for FY 2003
5. Check in the amount of $588.00

Application of Victor Giurgiutiu
Title: In-Situ Structural Health Monitoring, Diagnostics And Prognostics System Utilizing Thin Piezoelectric Sensors
Serial No: 10/072,644 filed: 2-8-02
Our Ref: 16139/09021
Date: September 4, 2003